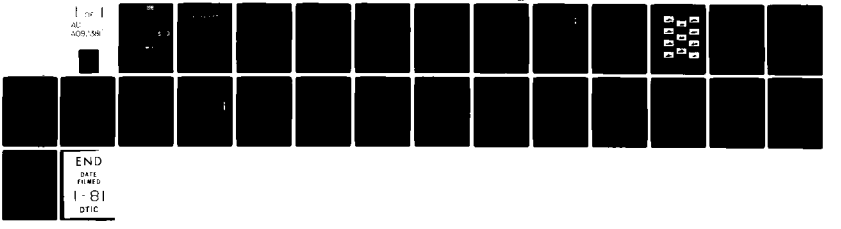
AD-A092 381 NAVAL WEAPONS CENTER CHINA LAKE CA F/G 17/8
EFFECT OF RESPONSE MODE ON TARGET IDENTIFICATION.(U)
JUN 80 S F NATHAN
UNCLASSIFIED NWC-TP-6202 SBIE-AD-E900 000 NL



END
DATE FILMED
1-81
DTIC

Effect of Response Mode on Target Identification

by

Steven F. Nathan

Systems Development Department

JUNE 1980

NAVAL WEAPONS CENTER
CHINA LAKE, CALIFORNIA 93555

Naval Weapons Center
AN ACTIVITY OF THE NAVAL MATERIAL COMMAND

FOREWORD

This report documents a study conducted in 1980 at the Naval Weapons Center, China Lake, Calif. The work was carried out under a target acquisition program supported by the Naval Air Systems Command under AIRTASK A03A3400/008B/7F55-525-000, and under the direction of Commander P. M. Curran, Naval Air Development Center, Warminster, Penn.

The Naval Weapons Center is conducting analysis and experimentation on several aspects of target acquisition, including detection and identification of targets by airborne sensors as well as by direct vision. This report describes a laboratory experiment of ship identification on a raster-type display.

Approved by
L. D. MARQUARDT, *Head (Actg)*
Systems Development Department
11 June 1980

Under authority of
W. B. HAFF
Capt., U.S. Navy
Commander

Released for publication by
R. M. HILLYER
Technical Director

NWC Technical Publication 6202

Published by . . . . . Technical Information Department
Collation . . . . . Cover, 12 leaves
First printing . . . . . 190 unnumbered copies

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1 REPORT NUMBER: NWC TP 6202	2 GOVT ACCESSION NO.: AD-A092 381
3 RECIPIENT'S CATALOG NUMBER	
4 TITLE (and Subtitle): EFFECT OF RESPONSE MODE ON TARGET IDENTIFICATION	5 TYPE OF REPORT & PERIOD COVERED: Target acquisition study 1980
6 PERFORMING ORG. REPORT NUMBER	
7 AUTHOR(s): Steven F. Nathan	8 CONTRACT OR GRANT NUMBER(s)
9 PERFORMING ORGANIZATION NAME AND ADDRESS: Naval Weapons Center, China Lake, CA 93555	10 PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: AIRTASK A03A3400/008B/ 7F55-525-000
11 CONTROLLING OFFICE NAME AND ADDRESS: Naval Weapons Center, China Lake, CA 93555	12 REPORT DATE: June 1980
	13 NUMBER OF PAGES: 22
14 MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15 SECURITY CLASS. (of this report): UNCLASSIFIED
	15a DECLASSIFICATION DOWNGRADING SCHEDULE

16 DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17 DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18 SUPPLEMENTARY NOTES

19 KEY WORDS (Continue on reverse side if necessary and identify by block number)

Target acquisition
Ship identification
Response mode
Image size
Exposure time

20 ABSTRACT (Continue on reverse side if necessary and identify by block number)

See back of form.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102 LF 014 6601

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

(U) *Effect of Response Mode on Target Identification*, by Steven F. Nathan. China Lake, Calif., NWC, June 1980. 22 pp. (NWC TP 6202, publication UNCLASSIFIED.)

(U) An experiment was conducted to determine the effects of two response modes (immediate versus delayed response) on target identification performance. Ship images were displayed sequentially, in sets of five, on a television monitor simulating infrared imagery. A prebriefed "target" ship appeared once in each set. "Immediate" responders designated targets at the time of presentation; "delayed" responders made a target designation after viewing each set.

(U) Observers' target identification performance was assessed as a function of image size (7, 10, and 13 TV lines) and image exposure time (2 and 4 seconds), as well as response mode. No difference in identification performance was found between response modes. Performance was significantly better for 10- and 13-line images than for 7-line images. Exposure time had no significant effect.

CONTENTS

INTRODUCTION

BACKGROUND

The ultimate success of a man-in-the-loop target acquisition system will depend on the capabilities and limitations of the human operator. Most imaging systems will require that the operator identify the target before conversion to attack.

Erickson has analyzed the flight dynamics of one such possible airborne imaging system, along with human performance data, to develop mission scenarios and system design alternatives.[1] His analysis suggested that an operator in a multiple-target scenario may not have sufficient time to view five widely separated objects in order to designate the desired target.

Whitehurst and Grossman conducted a study of ship identification performance under various conditions of exposure time and image size.[2] In that study, a "target" ship appeared once in every set of five ship images. Operators designated the target after all images in a set (viewed one after another) had been inspected. The operator could also respond, voluntarily, at the time the pre-briefed target ship was displayed (regardless of its order in the sequence). For each set, then, there was a forced-choice response, and for some sets a voluntary response. One result of that study indicated that observers did not perform better by waiting to view all five ships before responding. That is, voluntary performance was equal to forced-choice performance.

The implications of that result on Erickson's analysis suggest that considerable time can be saved, increasing the probability of a successful attack, if the observer can respond immediately to the target rather than delaying until he has seen all of the ships. However, in the Whitehurst/Grossman study observers only responded "immediately" to

---

[1] Naval Weapons Center. *Anti-Ship Missile Study; Man-in-the-Loop Operation*, by R. A. Erickson. China Lake, Calif., NWC, November 1979. (NWC TP 6112, publication UNCLASSIFIED.)

[2] Naval Weapons Center. *Effects of Image Exposure Time and Size on Ship Identification on Television*, by H. O. Whitehurst and J. D. Grossman. China Lake, Calif., NWC, February 1980. (NWC TP 6169, publication UNCLASSIFIED.)

the target's presence voluntarily, while the "delayed" response was a forced choice. Consequently, the question of voluntary versus forced-choice was confounded with the question of immediate versus delayed response.

OVERVIEW

The present study specifically addressed the question of response mode. The purpose was to determine how response mode (immediate versus delayed response) affected identification performance. As in the previous study, observers identified a target ship from among several alternatives under differing conditions of exposure time and image size. A television display was used to simulate infrared imagery. In this study, however, one group of observers responded after all five ships in a set were presented (as in the previous study), while a second group was required to respond when the target ship was presented.

METHOD

DESIGN

The experimental design, shown in Figure 1, was a variation of the split-plot design called a type SPF-p.qr.[3] There is one between-block treatment (A--response mode) and two within-block treatments (B--image size and C--exposure time). The independent variables were (1) length of time the ship image was present on the display (exposure time), (2) the number of scan lines on the raster that carried information about the image (image size), and (3) the response modes (immediate versus delayed). The dependent variable was the percentage of correct identifications of the ship that had been pre-briefed as the target.

APPARATUS

The videotapes employed in this experiment were those used for the previous experiment. The apparatus and procedures were reported by Whitehurst and Grossman.[2]

---

[3] R. E. Kirk. *Experimental Design: Procedures for the Behavioral Sciences.* Belmont, Calif., Brooks Cole Publishing Co., 1969. Pp. 298-99.

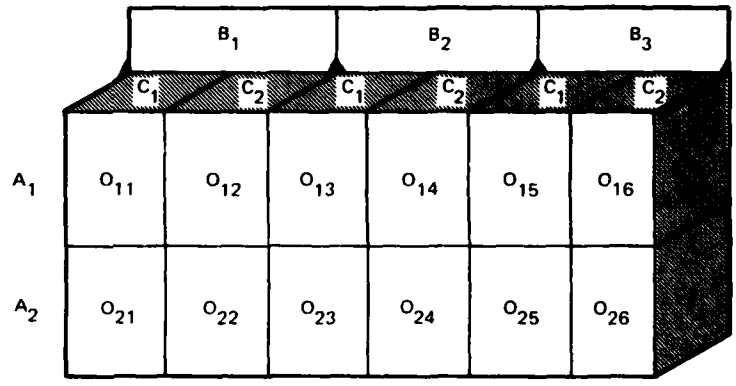


FIGURE 1. Experimental Design. A = response mode groups (immediate and delayed); B = image size (7, 10, and 13 lines); C = exposure time (2 and 4 seconds); O = observers.

A Sony Video Cassette recorder was used to play back videotapes to the observers. The observers' display was an SC Electronics, Inc. 9-inch, 525-line television monitor (Model 10M915). Table 1 shows the length and visual angle of the smallest and largest ship image for each level of image size.

TABLE 1. Ship Image Dimensions as Seen on the Display.

Image size, No. of TV lines across ship	Image length, in.	Visual angle,[a] min.
7	0.16-0.24	25-37.5
10	0.22-0.34	34-53
13	0.28-0.44	44-69

[a] Based on viewing distance of 22 inches.

An Esterline Angus series "S" Event Graph recorded responses. A Gamma Scientific, Inc. Telephotometer (Model IC 2000) was used to assure control of the luminances of the ship and background images when displayed on the TV monitor. The luminance of the ship images (L_t) was 16.2 ft-L, and that of the background (L_b) was 13.5 ft-L. The target/background contrast was 20 percent.*

* $$\% \text{ Contrast} = \frac{L_t - L_b}{L_b} \times 100$$

Observers were seated in a simulated aircraft cockpit during the experiment. The cockpit was equipped with the television monitor, a flight control stick grip (type B-8-A) connected to the response recorder, a knee-board box with five switches connected to the response recorder, a headphone, and a reference card with photographs of the 11 ships (see Figures 2 and 3). The videotape-recorder, response recorder, and another TV monitor for use by the experimenter were located in an adjoining area.

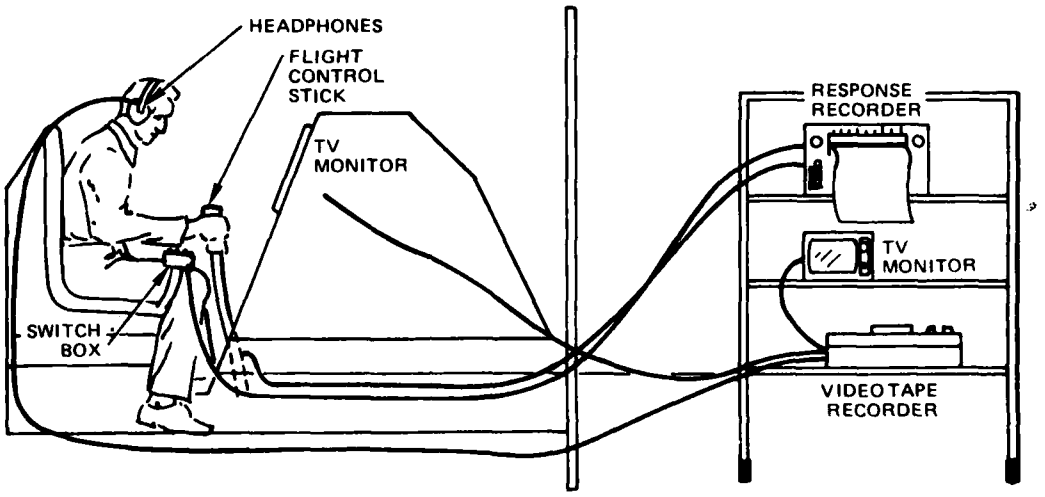


FIGURE 2. Testing Setup.

OBSERVERS

Eleven of the 12 naval aviators who participated in the Whitehurst/Grossman experiment also served as observers in the present study. All observers had at least 20/20 visual acuity at the time of their last annual Navy flight physical examination.

PROCEDURE

Videotape Recording

For a complete description of how the videotape recording was conducted, see Whitehurst and Grossman.[2] The following is a summary of the taping procedure:

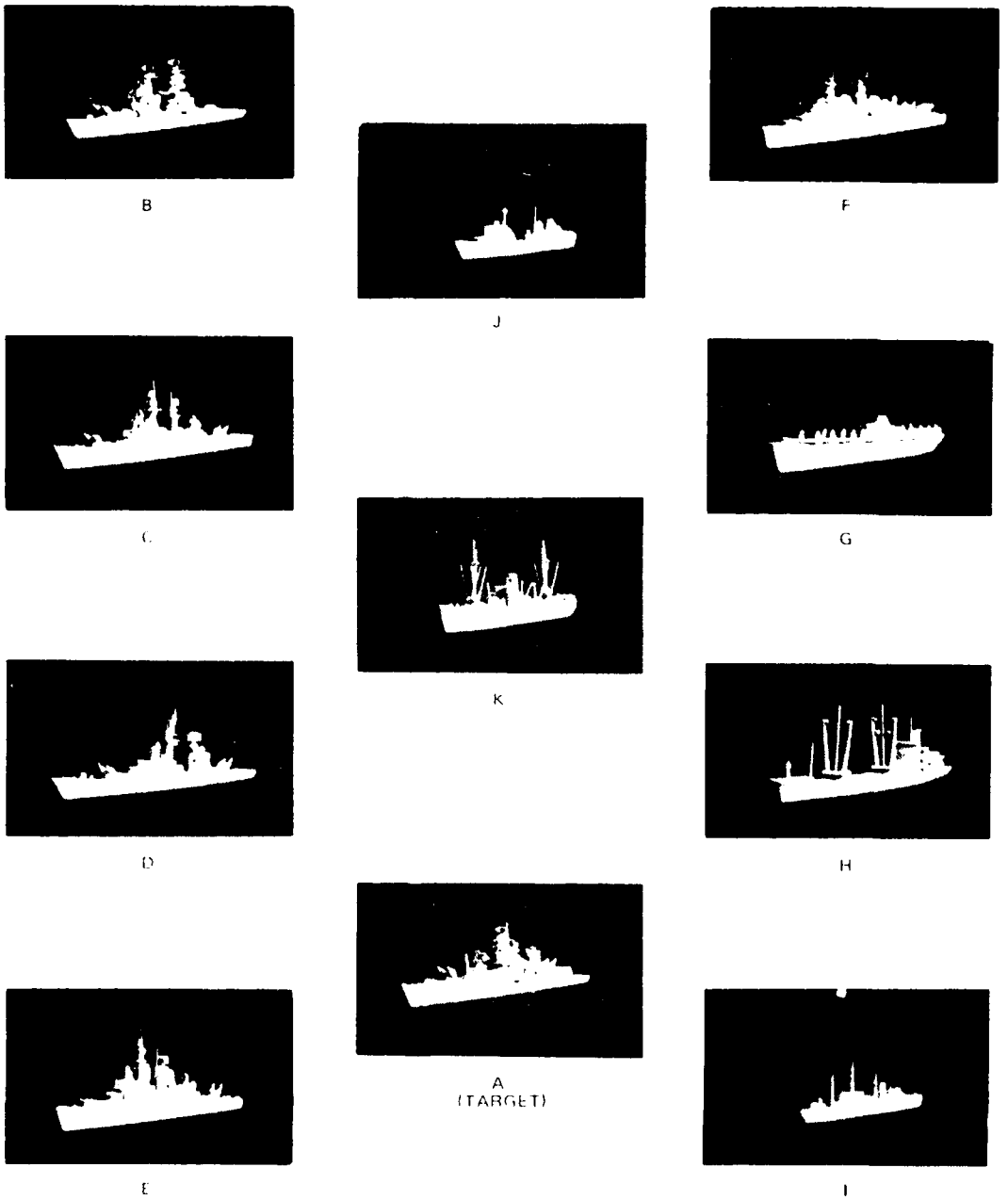


FIGURE 3. Photographs of the 1:1250-Scale Model Ships Used in the Experiment.

1. Ten trials (each consisting of five ship image presentations) were recorded at each of the exposure time (2 and 4 seconds) x image size (7, 10, and 13 TV lines) conditions.

2. Each set of five ships consisted of two combatants, two merchants, and the target.

3. The exposure times were videotaped in blocks. Randomized within each block were 10 trials at each level of image size (30 trials in all within a block).

4. The numbers one through five, corresponding to the image sequence during a trial, were recorded on the audio channel of the tape.

5. Practice trials were recorded with image sizes of 10, 20, and 30 TV lines and exposure times of 2 and 5 seconds. The word "target" was recorded on the tape at the time the target ship was on the display for the first 20 practice trials; the sequence number of the target was recorded after each set of five images. The final 20 practice trials were recorded without audio feedback.

Assignment of Observers to Groups

In order to match the two groups, observers were assigned to the groups on the basis of their scores from the previous experiment. Each observer was ranked according to the percentage of correct identifications he made. He was then paired with an observer who was ranked similarly. The pairing scheme is shown in Table 2.

TABLE 2. Pairing Scheme To Balance Immediate-Response and Delayed-Response Groups Based on Rankings From the Whitehurst/Grossman Experiment.

"Immediate" group	"Delayed" group
3[a]	2
4	5
7	8
10	9
11	12
A[b]	6

[a] The numbers in the table represent the i^{th} highest scorer from the previous experiment. The observer with the highest prior score was unavailable for this study; his replacement (A) was paired with an average scorer from the first experiment.

[b] Did not participate in Whitehurst/Grossman experiment.

Experimental Trials

Each observer was seated in the simulated cockpit and played recorded instructions (see Appendix A). The observers who were to respond immediately were shown the button on the control stick with which to respond. The observers who delayed responses were given the switch box to be strapped to a leg, and asked to ignore the control stick. After questions were answered, the 60 practice trials commenced. For the first 20 practice trials, the observers watched the ship images being presented on the TV display without responding. Each time the target ship appeared, the observers would hear the word "target" announced through the headphones. For the second 20 practice trials the observers responded as they would for the test trials. On these trials, the sequence number of the target was announced over the headphones a few seconds after the last ship in each set had been presented. The final 20 practice trials were identical to the data trials; no feedback was given.

A break of about 15 minutes occurred between the practice trials and the test trials. During this interval the ship and background luminances on the TV display were adjusted to a 20% contrast. Both blocks (two different exposure times) of test trials were split into three sections (set 1-10, 11-20, and 21-30), and their order of presentation was counterbalanced among observers.

RESULTS

DATA REDUCTION

The data consisted of 720 independent target identification responses (12 observers x 60 presentations to each observer). The percentages of correct identifications were computed for each observer under each of the six image size x exposure time conditions. Group totals were also calculated.

Response Mode

Figure 4 shows the percentage of correct identifications, for both response modes, as a function of image size across exposure time. Figure 5 shows the percentage of correct identifications for the two response modes as a function of exposure time, combining image sizes.

There was virtually no difference in overall target identification performance between the two response modes. The percentage of correct identifications, across image size and exposure time, for the immediate and delayed modes were 78% and 77%, respectively. For both groups, there

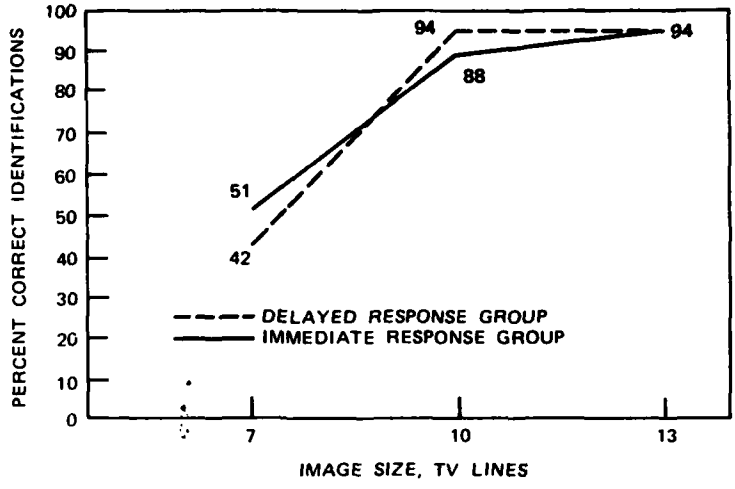


FIGURE 4. Percent Correct Identifications, "Immediate" and "Delayed" Groups, as a Function of Image Size.

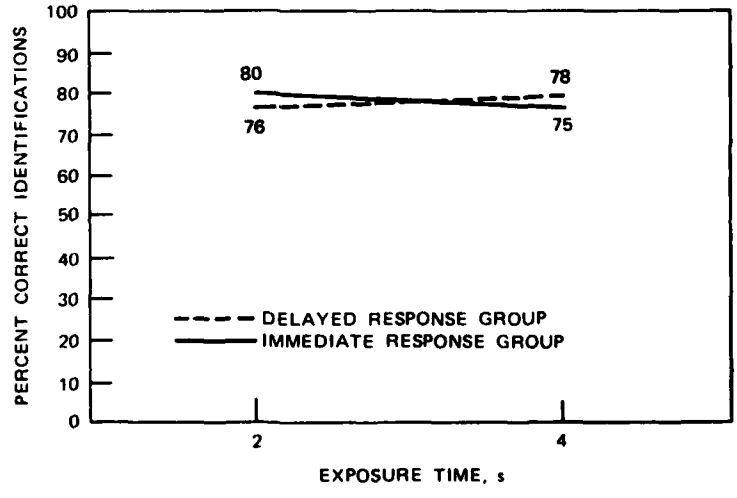


FIGURE 5. Percent Correct Identifications, "Immediate" and "Delayed" Groups, as a Function of Exposure Time.

were slightly more correct identifications at 4 seconds than at 2 seconds of exposure time at the 10- and 13-line image sizes. For the 7-line condition, there were slightly fewer correct identifications at 4 seconds than at 2 seconds. The difference is small (43% versus 41%) for the delayed-response group, but in the immediate-response group correct identifications drop from 60% to 41%.

Exposure Time

Figure 6 gives the percentage of correct identifications, across response modes, as a function of exposure time. Image sizes were combined. The effect of exposure time was minimal. The comparatively high percentage of correct identifications by the "immediate" group in the 7-line/2-second condition was enough to make the overall 2-second percentage greater than the overall 4-second percentage, but the difference is not significant.

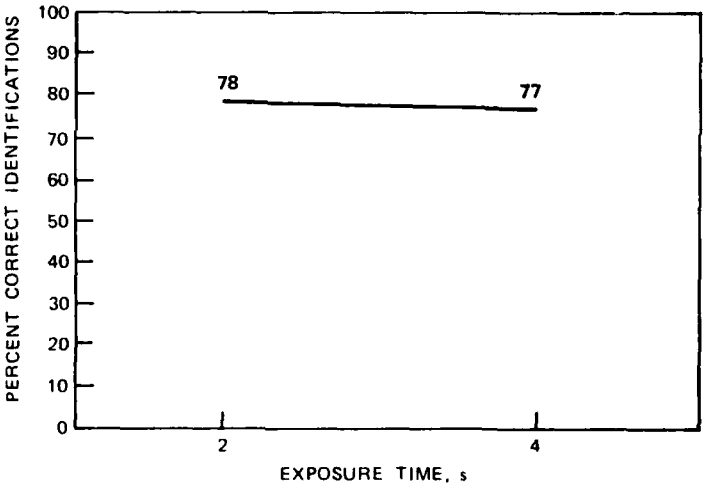


FIGURE 6. Percent Correct Identifications, Immediate- and Delayed-Groups Combined, as a Function of Exposure Time.

Image Size

In Figure 7, the percentage of correct identifications is plotted as a function of image size, combining response modes and exposure times. There was a pronounced improvement in performance with 10-line images over 7-line images, for both groups. Performance in the "immediate" group showed a small increase from 10 to 13 lines, while the "delayed" group's percentage was the same at 10 and 13 lines (see Figure 4).

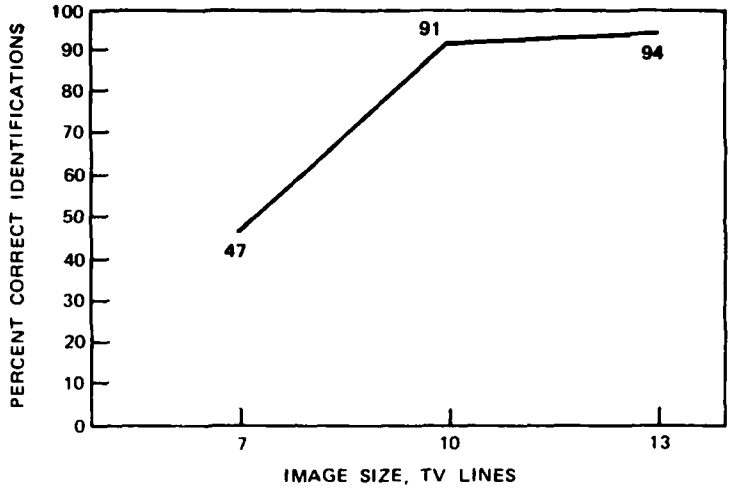


FIGURE 7. Percent Correct Identifications, "Immediate" and "Delayed" Groups Combined, as a Function of Image Size.

Presentation Sequence

Table 3 presents the frequency with which the target actually occurred in each position (1-5) of the sequence. Figure 8 displays the percentage of total errors (designations of ships that were not the pre-briefed target) as a function of the sequence number in which they occur. The "expected" percentages in Figure 8 reflect what would have occurred if the errors were evenly distributed.

TABLE 3. Frequency With Which Target Appeared in Each Position.

A	B	C
Ship sequence number	Number of times target appeared	Percent of total appearances
1	9	15
2	15	25
3	13	22
4	12	20
5	11	18

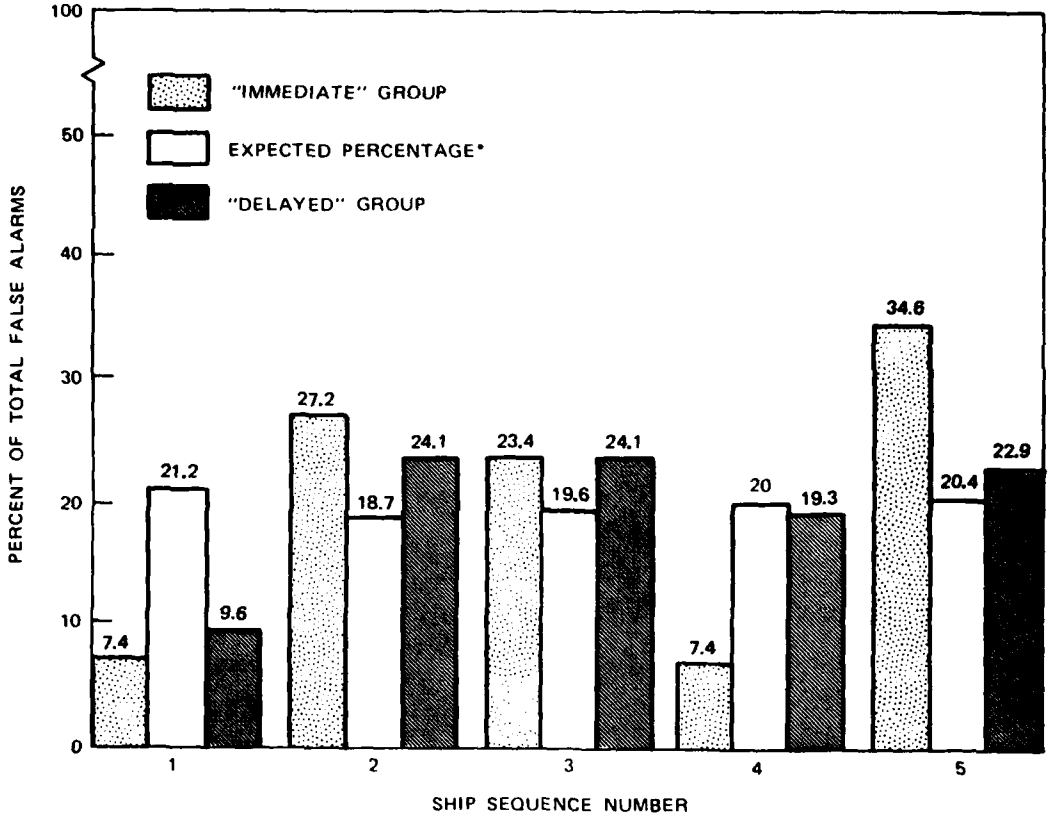


FIGURE 8. Percentage of Total Errors as a Function of Ship Sequence Number.

It was anticipated that a preponderance of errors would occur on the fifth ship for the immediate response mode. If the observer did not respond to any of the first four image presentations, he was then forced to designate the fifth presentation. This effect is suggested by Figure 8. Approximately 35% of the incorrect image designations by the "immediate" group occurred in the fifth position. For the "delayed" group, in which observers could designate any of the five ships after all had been viewed, incorrect designations occurred in the fifth position only 23% of the time. The expected percentage of false alarms in the fifth position was 20.4%.

---

* Expected percentage = $\dfrac{\left(\sum_{i=1}^{5} B_i\right) - B_i}{\sum_{i=1}^{5}\left[\left(\sum_{i=1}^{5} B_i\right) - B_i\right]}$ where B is the B column from Table 3.

Both groups had low error rates for the first presentations; and correspondingly the "hit" (correct designation) rate for the first presentations, in both groups, is relatively high. When performance is measured as a ratio of hits to misses, the first (7:1) and fourth (9:1) positions show the highest ratio while the fifth position (1.5:1) exhibits the lowest.

Ninety-Percentile Curves

For acceptable system performance the operators must be able to do the job most of the time. Therefore, it is helpful to know what sort of identification performance is characteristic of a large proportion of observers. Figure 9 presents the identification performance, as a function of image size, for nine out of ten observers.

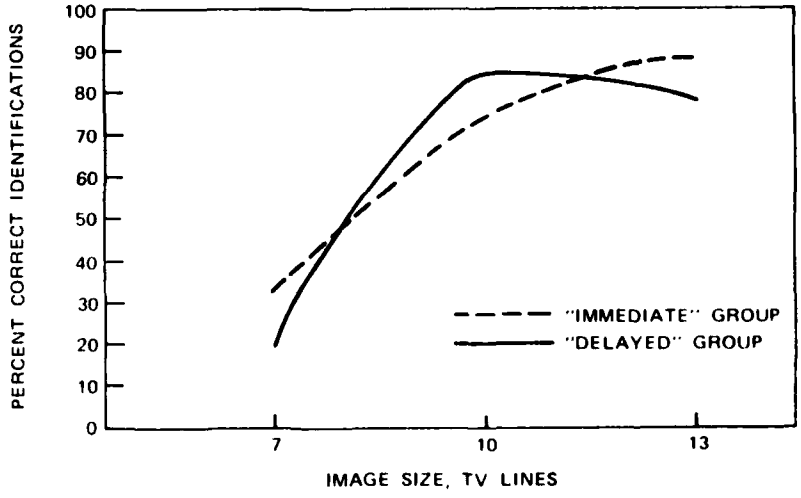


FIGURE 9. Percent Correct Identifications for 90th Percentile of Observers, as a Function of Image Size.

Confusion Matrix

Table 4 is a confusion matrix for each response mode condition as well as both conditions combined. The table shows the number of times each ship was designated as the target under each condition in the experiment.

Ship E (a combatant) was the one most often confused with the target ship (A) by both groups. Observers rarely mistook a merchant ship for the target. This occurred only three times out of 360 presentations to the "delayed" group. The "immediate" group designated a

TABLE 4. Number of Times Each Ship Was Designated as the Target Under Each Experimental Condition (With 60 Presentations for Each Condition).

Ships	Delayed group						Total	Immediate group						Total	Groups combined						Total
	Image size, TV lines							Image size, TV lines							Image size, TV lines						
	7		10		13			7		10		13			7		10		13		
	Exposure time, s							Exposure time, s							Exposure time, s						
	2	4	2	4	2	4		2	4	2	4	2	4		2	4	2	4	2	4	
Target (A)	26	25	55	58	56	57	277	36	25	52	54	56	57	280	62	50	107	112	112	114	557
Combatants																					
B	6	9	1	1	0	0	17	4	4	0	0	1	0	9	10	13	1	1	1	0	26
C	8	6	2	0	0	0	16	1	4	2	0	0	0	7	9	10	4	0	0	0	23
D	3	3	0	0	0	0	6	4	4	3	4	0	0	15	7	7	3	4	0	0	21
E	13	15	2	1	4	2	37	10	11	1	1	2	2	27	23	26	3	2	6	4	64
F	2	1	0	0	0	1	4	1	2	0	0	1	0	4	3	3	0	0	1	1	8
Merchants																					
G	0	0	0	0	0	0	0	0	2	1	0	0	0	3	0	2	0	0	0	0	3
H	1	0	0	0	0	0	1	0	2	0	1	0	0	3	1	2	0	1	0	0	4
I	0	0	0	0	0	0	0	0	0	1	0	0	1	2	0	0	1	0	0	1	2
J	0	0	0	0	0	0	0	1	6	0	0	0	0	7	1	6	0	0	0	0	7
K	1	1	0	0	0	0	2	3	0	0	0	0	0	3	4	1	0	0	0	0	5
Total	60	60	60	60	60	60	360	60	60	60	60	60	60	360	120	120	120	120	120	120	720

merchant as the target 18 times out of 360. However, many of these mistakes occurred at the fifth presentation in the sequence. An observer who had not made a designation prior to that was forced to do so even if the ship was clearly not the target.

ANALYSIS OF VARIANCE

Table 5 presents a summary of an analysis of variance on the experimental data.

TABLE 5. Summary, Analysis of Variance.

Source of variance	SS	DF	MS	F	P<	η^2
Observers (O)	1,773.62	5	354.72			3.49
Response condition (R)	12.50	1	12.50	.03	NS[a]	.02
R x O	2,562.50	5	512.50			5.04
Exposure time (E)	34.73	1	34.73	.35	NS	.07
E x O	773.62	5	154.72			1.52
E x R	168.04	1	168.04	1.71	NS	.33
Image size (I)	34,019.44	2	17,009.72	57.93	.001	66.97
I x O	1,830.56	10	183.05			3.60
I x R	608.33	2	304.16	1.04	NS	1.20
I x E	686.10	2	343.05	1.79	NS	1.35
R x E x I	252.78	2	126.39	.66	NS	.50
R x E x O	206.94	5	41.38			.40
R x I x O	4,041.66	10	404.16			7.95
E x I x O	2,430.55	10	243.05			4.78
E x I x O x R	1,397.22	10	139.72			2.75

[a] Not significant (P > .10).

This analysis indicates that the response mode had no effect upon the ability of observers to identify targets. Response mode accounted for only .02% of the variance in the data. Image size, as expected, accounted for by far the greatest proportion of variance (66.97%). Exposure time had virtually no impact on performance, accounting for only .07% of the variance in the data. None of the interactions between conditions in the experiment were statistically significant.

DATA COMPARISONS

Figure 10 compares the percentages of correct identifications, as a function of image size, from the present experiment and from the Whitehurst/Grossman experiment.

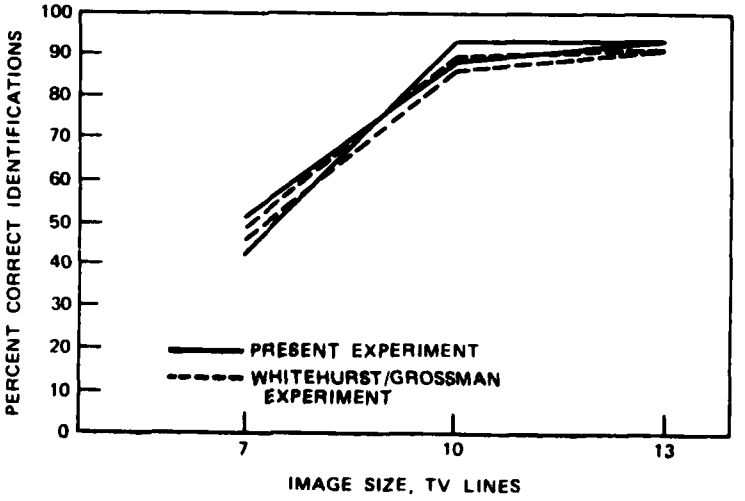


FIGURE 10. Percent Correct Identifications as a Function of Image Size. Curves compare present experiment to the Whitehurst/Grossman experiment.

The comparison indicates that target identification performance was very consistent between the two experiments. The observers in the present study correctly identified 77% of the targets, compared to 75% in the Whitehurst/Grossman study. Table 6 summarizes identification performance for each response mode in both experiments.

TABLE 6. Percent Correct Identifications for Forced-Choice and Voluntary Responses in the Whitehurst/Grossman Study and for "Immediate" and "Delayed Groups" in Present Study.

Whitehurst/Grossman experiment		Present experiment	
Forced-choice response	Voluntary response	Delayed group	Immediate group
75%	77%	76%	77%

Surprisingly, virtually identical performance was obtained for the voluntary response mode in the Whitehurst/Grossman study (77%) and the "immediate" group (where responses were forced) in the present study (77%). Apparently, forcing observers to respond when they are uncertain does not affect accuracy.

Several differences between the experiments that could have influenced performance should be noted: (1) The first experiment included a 6-second exposure-time condition, the second did not. (2) Only in the second study did the observers have previous experience in the experimental task. (3) The testing environment differed slightly (testing room versus simulated cockpit). (4) The line-of-sight distance between observer and TV monitor was approximately 14 inches in the previous study versus approximately 22 inches in the present study. (5) The two response modes in the first experiment were voluntary and forced choice; in the second experiment they were "immediate" and "delayed" forced choices.

The results of these experiments must be viewed in their proper context. The data was collected in the laboratory, not in the field. Such factors as aircraft motion, levels of observer attention, and motivation could significantly affect target identification performance.

DISCUSSION

The primary focus of this study was to determine whether or not ship identification/designation performance varied as a function of response mode. The response modes (at the time of viewing the image versus after viewing the entire set) caused no differences in the percent of correct target identifications. Observers who designated targets as soon as they saw them were as likely to make a correct identification as those who waited until they viewed the entire set before designating.

This result can be used in algorithms designed to determine strike capabilities of imaging systems. The assumption concerning the average search time requirement can be significantly reduced. Assuming that a target is equally likely to appear in any position of the sequence, a group of five ships that includes one target would present a probability of 20% that the target would appear at any position of the sequence. If the target appeared as the first in the sequence, an immediate designation would save 80% of the time required to view all of the ships before designation. If the target appeared second, 60% of the time would be saved, and so on. Combining sequence probabilities with time savings, the immediate response mode saves on the average, 40% of the time required for the delayed mode.

Image size (simulated range) had a significant effect on performance. At 7 lines, identification performance was much worse than at 10 and 13 lines. This further confirms the findings of several investigators,[4] including Whitehurst and Grossman, who have shown that approximately 10 scan lines across an image are a minimum requirement for target identification on television.

Allowing an observer 4 seconds, rather than 2 seconds, to inspect a ship image did not improve identification in the present study. Whitehurst and Grossman found that 4 seconds was significantly better than 2 seconds if the identification response was voluntary (and non-responses were included). The mode of an identification response (voluntary or forced-choice) may be dictated by the purpose of a particular mission; however, it seems unlikely that many missions would include voluntary target designation as a viable choice. It is more probable that groups of ships would be prioritized, and the missile operator would attempt to designate the ship with the highest priority within existing time constraints. In this situation the designation would be forced-choice. The results presented here suggest that a 2-second-per-ship inspection time would be sufficient.

[4] As summarized in: R. Erickson. "Line Criteria in Target Acquisition with Television," *Human Factors*, Vol. 20, No. 5, 1978, pp. 573-88.

Appendix A

INSTRUCTIONS TO OBSERVERS

IMMEDIATE-RESPONSE MODE

This experiment is being conducted to estimate an observer's ability to correctly identify a target ship from among several alternatives.

Note that there are 11 ship images on the board in front of you. The ship in the center is the target, the one which you will be asked to identify.

During this experiment you are to watch the monitor and try to identify the target ship when it appears by pressing the trigger on the joy stick. The target ship will appear once in every set of five image presentations. You may pull the trigger either while the target ship is on the display or in the short blank period which immediately follows each presentation. You must identify one, and only one, ship during each set of five.

During this phase of the experiment you will be given an opportunity to practice. For the first few trials you will not have to respond in any way. The target will be identified as it is presented. During the second part of the practice session, you should pull the trigger if you believe a ship to be the target. You will be given the actual target sequence number before the first ship in the next set of five is presented. The third phase of the practice session will be exactly like the experimental trials. No feedback will be given during these trials.

Do you have any questions?

DELAYED-RESPONSE MODE

This experiment is being conducted to estimate an observer's ability to correctly identify a target ship from among several alternatives.

Note that there are 11 ship images on the board in front of you. The ship in the center is the target, the one which you will be asked to identify.

During this experiment, as you watch the monitor, sets of five ship images will be presented. The target ship will appear once in every set, and your task will be to designate the target during the blank interval following each set. You will do this by pressing the button on the box which corresponds to the sequence number of the ship which you believe to be the target.

During this phase of the experiment you will be given an opportunity to practice. For the first few trials you will not have to respond in any way. The target will be identified as it is presented. During the second part of the practice session, you should push one of the five buttons after the last ship in each set has been presented. You will be given the actual target sequence number before the first ship in the next set of five is presented. The third phase of the practice session will be exactly like the experimental trials. No feedback will be given during these trials.

Do you have any questions?

INITIAL DISTRIBUTION

12 Naval Air Systems Command
- AIR-04 (1)
- AIR-104 (1)
- AIR-30212 (2)
- AIR-340D (1)
- AIR-340F (1)
- AIR-4131 (1)
- AIR-510 (1)
- AIR-5313 (2)
- AIR-950D (2)

6 Chief of Naval Operations
- OP-098 (1)
- OP-102X (1)
- OP-102XB (1)
- OP-55 (1)
- OP-982 (1)
- OP-987 (1)

2 Chief of Naval Material (MAT-0344)

4 Naval Sea Systems Command
- SEA-03 (1)
- SEA-03416 (1)
- SEA-99612 (2)

3 Chief of Naval Research, Arlington
- ONR-211 (1)
- ONR-455 (1)
- ONR-461 (1)

1 Bureau of Medicine & Surgery (Code 513)

1 Commandant of the Marine Corps

1 Air Test and Evaluation Squadron 4

1 Air Test and Evaluation Squadron 5

1 Naval Aerospace Medical Research Laboratory, Pensacola (Code L5)

6 Naval Air Development Center, Warminster
- Code 6003 (1)
- Code 602 (1)
- Code 6021 (1)
- Code 6022 (1)
- Code 603 (1)
- Technical Library (1)

1 Naval Air Force, Atlantic Fleet

1 Naval Air Force, Pacific Fleet

1 Naval Air Test Center (CT-176), Patuxent River (SY-72)

1 Naval Avionics Center, Indianapolis

1 Naval Ocean Systems Center, San Diego

4 Naval Postgraduate School, Monterey
  Dr. James Arima (1)
  Cdr. William Moroney (1)
  Dr. Gary Poock (1)
  Technical Library (1)
2 Naval Research Laboratory
1 Naval Submarine Medical Center, Naval Submarine Base, New London
1 Naval Surface Weapons Center, Dahlgren Laboratory, Dahlgren (Technical Library)
1 Naval Surface Weapons Center, White Oak (Technical Library)
2 Naval Training Equipment Center, Orlando
  Code 215 (1)
  Technical Library (1)
6 Naval Personnel Research and Development Center, San Diego
  Code 02 (1)
  Code 03 (1)
  Code 311 (2)
  Code 312 (2)
1 Office of Naval Research Branch Office, Pasadena
1 Operational Test and Evaluation Force
3 Pacific Missile Test Center, Point Mugu
  Code 1226 (2)
  Technical Library (1)
1 Office Chief of Research and Development
1 Army Armament Materiel Readiness Command, Rock Island (AMSAR-SAA)
3 Army Armament Research & Development Command, Dover
  DRDAR-LCE (1)
  DRDAR-LCE-V (1)
  DRDAR-SCF-DA (1)
1 Army Combat Developments Command, Armor Agency, Fort Knox
1 Army Combat Developments Command, Aviation Agency, Fort Rucker
1 Army Combat Developments Command, Experimentation Command, Fort Ord (Technical Library)
1 Army Combat Developments Command, Field Artillery Agency, Fort Sill
1 Army Missile Research and Development Command, Redstone Arsenal
1 Army Training & Doctrine Command, Fort Monroe
1 Aeromedical Research Laboratory, Fort Rucker
1 Army Ballistic Research Laboratories, Aberdeen Proving Ground (DRDAR-TSB-S (STINFO))
2 Army Human Engineering Laboratory, Aberdeen Proving Ground
2 Army Materiel Systems Analysis Agency, Aberdeen Proving Ground
3 Army Mobility Equipment Research and Development Center, Fort Belvoir
  Camouflage Laboratory (DRDME-RT) (2)
  Library (1)
1 Fort Huachuca Headquarters, Fort Huachuca
1 Night Vision Laboratory, Fort Belvoir (Technical Library)
1 Redstone Arsenal (DRXHE-MI)
1 White Sands Missile Range
1 Air Force Logistics Command, Wright-Patterson Air Force Base

1 Air Force Systems Command, Andrews Air Force Base (SDW)
1 Tactical Air Command, Langley Air Force Base
1 Aeronautical Systems Division, Wright-Patterson Air Force Base (ASD/AERS)
1 Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base (Code HEA)
1 Air Force Armament Laboratory, Eglin Air Force Base (Technical Library)
1 Oklahoma City Air Logistics Center, Tinker Air Force Base (MMSRG)
2 Pacific Air Forces
  Operations Analysis (Headquarters PACAF/OA) (1)
  Technical Library (1)
12 Defense Technical Information Center
2 Director of Defense Research & Engineering
  TST&E (1)
  DAD/E&LS (1)
1 Defense Intelligence Agency
1 Ames Research Center (NASA) (Aviation Safety Research Office, Technical Library)
1 Applied Physics Laboratory, JHU, Laurel, MD
2 Autonetics/Rockwell International Corporation, Anaheim, CA (Human Factors Group)
2 Calspan Corporation, Buffalo, NY (Life Sciences Avionics Dept.)
2 General Research Corporation, Santa Barbara, CA
3 Hughes Aircraft Company, Los Angeles, CA (Display Systems Department)
1 Human Factors Research, Incorporated, Goleta, CA (C-320)
2 Honeywell, Inc., Systems and Research Center, Minneapolis, MN (Library)
1 IBM, Owego, NY (Human Factors Group, 304A535)
1 Institute for Defense Analyses, Arlington, VA (Technical Library)
2 McDonnell Douglas Corporation, Long Beach, CA (Director, Scientific Research, R & D Aircraft Division)
2 McDonnell Douglas Corporation, St. Louis, MO (Engineering Psychology)
2 Martin-Marietta Corporation, Orlando, FL
  Image Processing Laboratory - (MS 362) (1)
  Technical Library (1)
1 National Academy of Sciences, Vision Committee, Washington, D.C.
1 Perceptronics, Inc., Woodland Hills, CA
1 Rockwell International Corporation, Columbus, OH (Technical Library)
5 The Boeing Company, Seattle, WA (Crew Systems MS-41-44)
1 The Rand Corporation, Santa Monica, CA (Natalie E. Crawford)
1 University of California, Scripps Visibility Laboratory, San Diego, CA
2 Virginia Polytechnic Institute, Blacksburg, VA (Industrial Engineering Department)
2 Vought Corporation, Systems Division, Dallas, TX (Human Factors Group)